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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	<b>Application No.</b> 10/575,352	<b>Applicant(s)</b> SMALLEY ET AL.	
	<b>Examiner</b> DANIEL C. MCCracken	<b>Art Unit</b> 1736	

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 13 April 2011.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-26 and 28-78 is/are pending in the application.
- 4a) Of the above claim(s) 39-73 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-26, 28-38 and 74-78 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 13 April 2011 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)            | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftperson's Patent Drawing Review (PTO-948)    | Paper No(s)/Mail Date. _____                                      |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____  | 6) <input type="checkbox"/> Other: _____                          |

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### **DETAILED ACTION**

Citation to the Specification will be in the following format: (S. # : ¶/L) where # denotes the page number and ¶/L denotes the paragraph number or line number. Citation to patent literature will be in the form (Inventor # : LL) where # is the column number and LL is the line number. Citation to the pre-grant publication literature will be in the following format (Inventor # : ¶) where # denotes the page number and ¶ denotes the paragraph number.

#### ***Status of Application***

The response dated 4/13/2011 has been received and will be entered. Claims 1-26 and 28-78 are pending. Claims 39-73 are withdrawn from consideration. Claims 1, 7-9, 19-23, 26, 28-29, 36, 38 and 74 are currently amended. Claim 27 is acknowledged as cancelled.

#### ***Response to Arguments***

##### **Drawings**

I. With respect to the objection to Figure 6 for failing to designate it prior art, the objection is WITHDRAWN in light of the replacement drawing submitted.

##### **Claim Rejections – 35 U.S.C. §101**

I. With respect to the rejection of Claims 8 and 26-27 are rejected under 35 U.S.C. 101, the traversal appears to rely on amendments (Remarks of 4/13/2011 at 15). The amendments are persuasive. The rejection is WITHDRAWN.

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Claim Rejections – 35 U.S.C. §112

I. With respect to the rejection of Claims 8, 19-38 and 76-78 under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention, this rejection and the grounds set forth therein was not specifically traversed. The Remarks appear to rely on amendments. (Remarks of 4/13/2011 at 15).

The Remarks do not address the aspirational/indefinite “scalable so as to produce multi-kilogram quantities” language of Claim 22 noted in the rejection. The rejection of this claim is maintained.

Claim 23 was not traversed. The mental step/pre-selected language was not addressed. This rejection is maintained.

Claim 28 and the “attaching”/”docking” distinction was not addressed or traversed. Docking is unclear in light of the disclosure *vis-à-vis* “attaching.” This rejection is maintained.

The rejections of these claims are MAINTAINED. All rejections of all other claims are WITHDRAWN in light of the amendments.

Claim Rejections – 35 U.S.C. §102

I. With respect to the rejection of Claims 1-3, 6-10, 13, 17-18, 20, 22, 19, 21-25, 31, 34-38, 29, and 76-78 under 35 U.S.C. 102(b) as being anticipated by US 2002/0004028 to Margrave, et al., the Remarks argue a newly claimed feature. (Remarks of 4/13/2011 at 15) (“Margrave does not disclose any methods for ‘sorting...carbon nanotubes by electronic type’, as currently required for the rejected claims.”) (emphasis added). The “electronic type”

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limitation was not present in the claims as previously pending and rejected. Because of this amendment narrowing the generic “type” to the specific “electronic type,” the rejection is WITHDRAWN.

Claim Rejections – 35 U.S.C. §103

Five separate rejections under 35 U.S.C. 103 were made in some combination with the Margrave reference. These have been traversed *en masse*. (Remarks of 4/13/2011 at 16). While a page of discussion devoted to the *prima facie* case of obviousness was provided (Remarks of 4/13/2011), the arguments appear to be directed towards the newly claimed embodiment. *See* (Remarks of 4/13/2011 at 17-18) (noting that the newly added “electronic type” limitation is underlined seven times). The “electronic type” limitation was not present in the claims as previously pending and rejected. Because of this amendment narrowing the generic “type” to the specific “electronic type,” the obviousness rejections set forth in the Non-final Office Action of 12/13/2010 (Rejections I-V) are WITHDRAWN.

In the Non-final Office Action, official notice was taken with respect to various facts. *See* (Non-final Office Action of 12/13/2010, Rejections I-V). Applicants have not traversed the assertion of official notice. As such, the common knowledge/well-known in the art statement is taken to be admitted prior art. *See* MPEP 2144.03 C (“If applicant does not traverse the examiner’s assertion of official notice or applicant’s traverse is not adequate, the examiner should clearly indicate in the next Office action that the common knowledge or well-known in the art statement is taken to be admitted prior art because applicant either failed to traverse the examiner’s assertion of official notice or that the traverse was inadequate.”).

***Claim Rejections - 35 USC § 112***

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

**I. Claims 22, 23 and 28 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.**

With respect to Claim 22, it is unclear whether anything is required by this claim, *i.e.* does the process make “multi-kilogram quantities” or is this merely aspirational?

With respect to Claim 23, the mental step of “*pre-select[ing]*” the chirality and diameter makes it impossible to ascertain the scope of the claim. What is the difference between a pre-selected nanotube of a particular chirality/diameter and one that is randomly produced?

With respect to Claim 28, the repetitive language “attaching” and “docking” is not understood. Does attaching something not dock it? Is limitation (b) really just describing a reducing step? The specification *might* suggest this. (S. 13: [0055]) If so, the Examiner suggests saying just that, *i.e.* “reducing the product of step a,” etc. As drafted, the claim requires two docking steps and this is not understood in light of the disclosure.

***Claim Rejections - 35 USC § 103***

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

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**I. Claims 1-3, 6-7, 10, 13, 17-18, 19, 20, 22, 19, 21, 22, 23, 24-25, 28, 31, 34, 37, 29, 36, 38, 76, and 77-78 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 2002/0004028 to Margrave, et al. in view of (i) Applicants admissions.**

With respect to Claim 1, this claim requires “a) providing a plurality of carbon nanotubes.” Margrave teaches providing a plurality of nanotubes. *See e.g.* (Margrave 14: [0169]).

Claim 1 further requires “b) cutting the carbon nanotubes to provide cut carbon nanotubes comprising lengths on the order of tens of nanometers.” Margrave teaches cutting. *Id.* (“A process in which one cuts segments of SWNTs.”).

Claim 1 further requires “c) sorting the cut carbon nanotubes by electron type to provide sorted cut carbon nanotubes.” Margrave teaches sorting. *Id.* (“selects tube segments of a specific range”). To the extent Margrave *may* not teach sorting by electronic type, this does not impart patentability. Sorting/separating nanotubes by electronic type is old and known, and the Examiner takes official notice that it is. In support of taking official notice, *i.e.* in making sure there is “substantial evidence” on the record, the Examiner relies on Applicants admissions. Applicants have stated on and for the record in their own specification that:

Methods for separating CNTs by electronic type have been reported. See D. Chattopadhyay et al., J. Am. Chem. Soc., 2003, 125, 3370; M. Zheng et al., Science, 2003, 302, 1545-1548; Weisman, Nat. Mater., 2003, 2, 569-570; and commonly assigned, co-pending U.S. patent applications Ser. Nos. 10/379,022 and 10/379,273, both filed Mar. 4, 2003. Additionally, methods for selectively functionalizing CNTs by type have also emerged. See Strano et al., Science, 2003, 301, 1519-1522; L. An et al., J. Am. Chem. Soc., 2004, 126(34), 10520-10521; and commonly assigned, co-pending International Patent Application Serial No. PCT US04/24507, filed Jul. 29, 2004.

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(S. 3: [0010]). One would be motivated to sort the nanotubes by electronic type for any number of reasons, *e.g.* purifying. “[A]n implicit motivation to combine exists not only when a suggestion may be gleaned from the prior art as a whole, but when the improvement’ is technology-independent and the combination of references results in a product or process that is more desirable, for example because it is stronger, cheaper, cleaner, faster, lighter, smaller, more durable, or more efficient. Because the desire to enhance commercial opportunities by improving a product or process is universal-and even common-sensical-we have held that there exists in these situations a motivation to combine prior art references even absent any hint of suggestion in the references themselves. In such situations, the proper question is whether the ordinary artisan possesses knowledge and skills rendering him capable of combining the prior art references.” *DyStar Textilfarben GmbH & Co. Deutschland KG v. C.H. Patrick Co.*, 464 F.3d 1356, 1368, 80 USPQ2d 1641, 1651 (Fed. Cir. 2006). Furthermore, use of known techniques to improve known methods does not impart patentability. *See* MPEP 2143.

Claim 1 further requires “d) docking at least some of the sorted cut carbon nanotubes to metal catalyst precursors to form carbon nanotube seeds.” Margrave teaches bonding (*i.e.* docking) metal (iron) to the tube. *Id.*

Claim 1 further requires “e) growing the carbon nanotube seeds to form a carbon nanotube product of increased length.” The “seed” is grown to increase length. *See e.g.* (Margrave 15: [0181] *et seq.*) (“subjected to tube growth (extension) conditions.”).

As to Claims 2-3, at least SWNT are disclosed. (Margrave 14: [0161]). As to Claim 6, derivatization is taught. *See e.g.* (Margrave 14: [0169]), (Margrave 1: [0010]) (“Derivitization of Single-wall Nanotubes”). As to Claim 7, see discussion of admissions above. As to Claim 10,



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clusters are taught. (Margrave 14: [0168]). As to Claim 13, catalyst are attached/docked. (Margrave 14: [0169]). As to Claim 17, reducing is taught. (Margrave 14: [0169]). As to Claim 18, hydrogen is taught. *Id.* As to Claim 20, growth in a gas stream (*i.e.* making a seed aerosol) is taught. *See e.g.* (Margrave 17: [0198 *et seq.*]). As to Claim 22, “tons per day,” *i.e.* “multi-kilogram” quantities is taught. (Margrave 16: [0193]). As to Claim 19, supports are taught. *See e.g.* (Margrave 17: [0197]). As to Claim 21, hydrogen (Margrave 15: [0179]) and CO (Margrave 16: [0182]) is taught. As to Claim 22, see (Margrave 16: [0187]).

With respect to Claim 23, notwithstanding the ambiguities associated with this claim, this claim requires “a) providing a plurality of carbon nanotubes, wherein substantially all of the carbon nanotubes are of a sorted pre-selected chirality and diameter that have been sorted by electronic type.” Margrave teaches providing nanotubes of specific diameter and chirality. (Margrave 14: [0163]). The discussion of electronic type, Applicant’s admissions, etc. set forth in connection with Claim 1 *supra* is relied upon.

Claim 23 further requires “b) forming carbon nanotube seeds from the plurality of carbon nanotubes.” Seeds/catalysts are formed. (Margrave 14: [0162]).

Claim 23 further requires “c) growing the carbon nanotube seeds in a growth environment to provide a carbon nanotube product comprising carbon nanotubes of increased length and of the pre-selected chirality, diameter and electronic type.” The nanotubes are grown. (Margrave 14: [0163]).

As to Claims 24-25, at least SWNT are taught. (Margrave 14: [0169]). As to Claim 28, notwithstanding the ambiguities above, docking and reducing are taught. (Margrave 14: [0169]). As to Claim 31, metal clusters are taught. *Id.* As to Claim 34, organometallics are taught.

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(Margrave “Claim 14”). As to Claim 35, hydrogen is taught. (Margrave 14: [0169]). As to Claim 37, gas phase/aerosol growth is taught. *See e.g.* (Margrave 17: [0198 *et seq.*]). As to Claim 29, cutting with the claimed dimensions is taught. *Id.* As to Claim 36, notwithstanding the ambiguities associated with this language, supports are taught. (Margrave 17: [0197]). As to Claim 38, hydrogen (Margrave 15: [0179]) and CO (Margrave 16: [0182]) is taught. As to Claim 76, the claimed phenomena is taught. (Margrave 15: [0179]). As to Claims 77-78, at least SWNT are taught. (Margrave 14: [0169]).

To the extent the discussion of Margrave *supra* can be properly characterized as combining different embodiments from a listing of embodiments within the Margrave reference, this does not impart patentability. The articulated rationale is that any combination of the techniques taught by Margrave would appear to be a combination of known techniques (“seed growth,” attachment, etc.) to achieve predictable results (carbon nanotubes). This does not impart patentability. *See* MPEP 2143.

**II. Claims 8-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 2002/0004028 to Margrave, et al. and Applicant’s admissions as applied to claim 7 above, and further in view of Strano, et al., *Electronic Structure Control of Single-Walled Carbon Nanotube Functionalization*, Science 2003; 301: 1519-1522 (hereinafter “Strano at \_\_”)**

The discussion of Margrave and Applicant’s admissions accompanying Rejection I *supra* is expressly incorporated herein by reference. As to Claim 8, selective precipitation is a known technique for sorting by electronic type and the Examiner takes official notice that it is. In support of taking official notice, *i.e.* in making sure there is “substantial evidence” on the record, the Examiner provides Strano. *See e.g.* (Strano at 1522) (“Hence, this selective chemistry can be

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used as a reversible route to separate, deposit, or chemically link nanotubes of a particular electronic structure.”). All of Strano is relevant and relied on. As to Claim 9, functionalization is used to sort. (Strano at 1520).

**III. Claims 4 and 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over US 2002/0004028 to Margrave, et al. and Applicants’ admissions as applied to claim 1 above, and further in view of US 6,413,487 to Resasco, et al.**

The discussion of Margrave and Applicant’s admissions accompanying Rejection I *supra* is expressly incorporated herein by reference. As to Claim 4, to the extent Margrave may not disclose the recycle operation, these are known in nanotube synthesis and the Examiner takes official notice that they are. In support of taking official notice, *i.e.* in making sure there is "substantial evidence" on the record, the Examiner provides the Resasco reference. *See e.g.* (Resasco “Abstract”) (“The method also contemplates methods and apparatus which recycle and reuse the gases and catalytic particulate materials, thereby maximizing cost efficiency, reducing wastes, reducing the need for additional raw materials, and producing the carbon nanotubes, especially SWNTs, in greater quantities and for lower costs.”) One would be motivated to employ a recycle stream to “maximize cost efficiency,” as taught by Resasco. As to Claim 16, to the extent Margrave may not teach purification, this too is old and known and the Examiner takes official notice that it is. In support of official notice, Resasco is provided. *See* (Resasco “Fig 1”) (note at least step I). Purifying is an obvious expedient to arrive at a pure product for other applications, etc.

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**IV. Claims 5 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 2002/0004028 to Margrave, et al. as applied to claim 1 and 29 above, and further in view of Gu, et al., *Cutting Single-Wall Carbon Nanotubes through Fluorination*, Nano Letters 2002; 2(9): 1009-1013 (hereinafter “Gu at \_\_”).**

The discussion of Margrave and Applicant's admissions accompanying Rejection I *supra* is expressly incorporated herein by reference. As to Claim 5 and Claim 30, Margrave teaches cutting, but with sonication. (Margrave 14: [0169]). To the extent Margrave does not teach the cutting claimed, *e.g.* fluorination, this does not impart patentability. Fluorination as a cutting technique is old and known and the Examiner takes official notice that it is. In support of taking official notice, *i.e.* in making sure there is “substantial” evidence on the record, the Examiner provides Gu. *See* (Gu, entire document, title). Substitution of the two is an obvious expedient, as the techniques appear to be recognized equivalents and both publications are by the same authors, who happen to be the inventors.

**V. Claims 11-12, 14-15, 32-34 and 74-75 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 2002/0004028 to Margrave, et al. as applied to claim 3 and 28 above, and further in view of:**

**(i) An, et al., *Synthesis of Nearly Uniform Single-Walled Carbon Nanotubes Using Identical Metal-Containing Molecular Nanoclusters as Catalysts*, J. Am. Chem. Soc. 2002; 124(46): 13688-13689 (hereinafter “An at \_\_”).**

The discussion of Margrave and Applicant's admissions accompanying Rejection I *supra* is expressly incorporated herein by reference. As to Claim 11, to the extent Margrave may not teach the catalyst as claimed, note the combined teachings: Margrave teaches that a host of catalysts are suitable. (Margrave 15: [0175]). Margrave also teaches as an object of the invention to control diameter of the nanotubes. *See e.g.* (Margrave 14: [0163]). An teaches that nanotubes with controlled diameters can be grown from Fr-Mo nanoclusters. (An at 13689, col. 1-2). An

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appears to employ the compound designated by Applicants as “FeMoC.” (An at 13688, col. 1). One would be motivated to employ the nanocluster of An in the process of Margrave to control diameter of the nanotubes, as taught and suggested by both Margrave and An. As to Claim 12, use of a known solvent like ethanol is an obvious expedient to facilitate the reactions in solution, as taught by Margrave. (Margrave 8: [0100], [0130 *et seq.*]). As to Claim 14-15, the carboxylic chemistry appears suggested by the combination. *See also* (Margrave 14: [0171]). As to Claims 32-34, the discussion of Claims 11 and 14 is relied upon. FeMoC is an organometallic.

With respect to Claims 74-75, these claims combine other claimed embodiments addressed above. The discussion of Margrave and Applicant’s admissions accompanying Rejection I *supra* is expressly incorporated herein by reference, as well as the An rejection is relied upon, *mutatis mutandis*.

**VI. Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over US 2002/0004028 to Margrave, et al. as applied to claim 25 above, and further in view of Dillon, et al., *Hydrogen storage using carbon adsorbents: past, present and future*, Appl. Phys. A 2001; 72: 133-142 (hereinafter “Dillon at \_\_”).**

The discussion of Margrave and Applicant’s admissions accompanying Rejection I *supra* is expressly incorporated herein by reference. As to Claims 26, notwithstanding the ambiguities associated with this claim, to the extent Margrave *may* not teach hydrogen storage, this use of carbon nanotubes is old, known and well described in the literature. The Examiner takes official notice that it is. In support of taking official notice, *i.e.* in making sure there is “substantial evidence” on the record, the Examiner provides Dillon. *See* (Dillon, entire document). Use of a known material consistent with its known uses would be obvious to the skilled artisan in light of the explicit teachings identified above.

### *Conclusion*

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

1. US 2004/0040834 to Smalley, et al.
2. US 2004/0038251 to Smalley, et al.

Both Smalley references, provided on the IDS of 4/14/2011 are relevant for sorting/separating, etc. nanotubes. At this time, any rejections were considered cumulative to those of record.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to DANIEL C. MCCracken whose telephone number is (571)272-6537. The examiner can normally be reached on Monday through Friday, 9 AM - 6 PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stanley S. Silverman can be reached on (571) 272-1358. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Daniel C. McCracken/  
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DCM